

**Interface Requirements Document
Between The Earth Observing
System Data and Information
System (EOSDIS) Core System
(ECS) And The Stratospheric
Aerosol and Gas Experiment
(SAGE III) Mission Operations
Center (MOC)**

July 1996



National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

INTERFACE REQUIREMENTS DOCUMENT
between the
EOSDIS Core System (ECS) and the
Stratospheric Aerosol and Gas Experiment (SAGE III)
Mission Operations Center (MOC)

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Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. This document is under ECS contractor configuration control. Once this document is approved, Contractor approved changes are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

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Abstract

The Earth Observing System Data and Information System (EOSDIS) Core System (ECS) involves the collection and distribution of data from space and ground based measurement systems to provide the scientific basis for understanding global change. Using ECS as their window to the EOSDIS, the world wide science community is able to access data from a distributed archive in the United States and from international Earth Science support systems. To accomplish this mission, it is necessary for ECS to interface to a wide variety of external systems. This document presents the requirements to provide an interface between ECS and the SAGE III Project located at the Langley Research Center, Hampton, Virginia.

The ECS contractor team used the process described in the ECS Methodology for Definition of External Interfaces document to develop these interface requirements. Memoranda of Understanding (MOUs), Project Implementation Agreements (PIAs), the Earth Science Data and Information System (ESDIS) Project—Level 2 Requirements, and the Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System (the ECS Level 3 requirements document) were used in the methodology to evolve this formal Interface Requirement Document (IRD).

Keywords: SAGE III, ECS, Mission Operations Center, Meteor, DAAC, Level 0, interface, notification, metadata, orbit, view

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1. Introduction

1.1 Identification

This Interface Requirement Document (IRD), Contract Data Requirement List (CDRL) item 039, whose requirements are specified in Data Item Description (DID) 219/SE1, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-60000). It defines the interface requirements between ECS and the Stratospheric Aerosol and Gas Experiment (SAGE) III Project.

1.2 Scope

This IRD defines all of the system data interfaces that exist between ECS and the SAGE III Mission Operations Center (MOC). This document is also intended to conform to the terms and conditions of the Working Agreement Between the Goddard Space Flight Center (GSFC) and the Langley Research Center (LaRC) for Conduct of the Stratospheric Aerosol and Gas Experiment III (SAGE III). It should be noted that this document is intended to support the functional interface requirements for the SAGE III instrument on the Russian Meteor-3M spacecraft. Future interface requirements between the ECS and the SAGE III project, i.e., supporting Space Station and Flight of Opportunity will be addressed in this document in the future (as ECS is contracted to support additional interfaces).

1.3 Purpose and Objectives

This document is written to formalize the interpretation and general understanding of the interface between ECS and the SAGE III MOC. For ECS, this document provides a clarification and elaboration of the ECS/SAGE III MOC interface requirements from the Functional and Performance Requirements (Level 3) for the EOSDIS Core System. It is meant to stand alone as a total document and contains more detail in regards to interface requirements than a Level 3 requirements specification.

The objective of this document is to provide a focus for defining a related Interface Control Document (ICD) which is jointly developed by the ECS and the SAGE III MOC to cover each system interface identified in this IRD.

The ESDIS Project has joint responsibility with the SAGE III Project for the development and maintenance of this IRD. Any changes in the interface requirements must be agreed by the relevant participating parties, and then assessed at the ESDIS Project level. This IRD will be approved under the signature of the ESDIS Project Manager and the SAGE III Project Manager (or delegate).

1.4 Status and Schedule

This document is submitted to the ECS CCB as a final IRD. As a formal contract deliverable with approval code 1, this document requires Government review and approval prior to acceptance and use. This document will be under full Government CCB control.

Changes may be submitted for consideration by Contractor and Government Configuration Control Boards (CCBs) under the normal change process at any time.

1.5 Document Organization

This Interface Requirements Document is organized as described below:

- Section 1 Introduction - Introduces the IRD's scope, purpose, objectives, status, schedule, and document organization.
- Section 2 Related Documentation - Provides a bibliography of reference documents for the IRD organized by parent, applicable, and information subsections.
- Section 3 Systems Description - Provides an overview of both systems and a discussion of the system components involved in the interface. An overview diagram depicting the functional interfaces is also included.
- Section 4 Data Flow Descriptions- Provides a discussion of how the interface is used from an operational point of view. A context diagram depicting the data flows is included.
- Section 5 Functional Interface and Performance Requirements - Requirements are sorted for presentation by denoting functional type. Traceability to parent documents is also noted in this section.
- Section 6 Interface Control Documentation Plan - Identifies and summarizes the ICD(s) that will be derived from this IRD.
- Appendix A Data Volumes
- Appendix B Requirements Traceability

2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content derive:

| | |
|-----------------|---|
| 193-208-SE1-001 | Methodology for Definition of External Interfaces for the ECS Project |
| 423-10-01-1 | Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) Level 2 Requirements EOSDIS Core System (ECS), Volume 1, January 27, 1993 |
| 423-41-01 | Goddard Space Flight Center, EOSDIS Core System Statement of Work, May 21, 1993 |
| 423-41-02 | Goddard Space Flight Center, Functional and Performance Requirements Specification for the EOSDIS Core System, May 21, 1993 |
| 475-00-01 | Langley Research Center, Working Agreement Between the Goddard Space Flight Center (GSFC) and the Langley Research Center (LaRC) for Conduct of the Stratospheric Aerosol and Gas Experiment III (SAGE III) |

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, this document shall take precedence.

| | |
|------------------|---|
| 301-CD-002-003 | System Implementation Plan for the ECS Project |
| 305-CD-025-002 | Release B SDPS Ingest Subsystem Design Specification for the ECS Project |
| 311-CD-002-004 | Science Data Processing Segment (SDPS) Database Design and Database Schema Specifications for the ECS Project |
| 210-TP-001-005 | Technical Baseline for the ECS Project |
| 475-01-01 | Langley Research Center, SAGE III Mission Operations Concept |
| 510-ICD-EDOS/EGS | Goddard Space Flight Center, Earth Observing System (EOS) Data and Operations System (EDOS) Interface Control Document Between the Earth Observing System (EOS) Data and Operations System (EDOS) and the EOS Ground System (EGS) Elements CDRL B301, January 19, 1996, Final |

2.3 Information Documents

The following documents, although not directly applicable, amplify or clarify the information presented in this document, but are not binding.

| | |
|-----------------|---|
| 193-201-SE1-001 | Systems Engineering Plan for the ECS Project |
| 193-202-SE1-001 | ECS Standards and Procedures for the ECS Project |
| 209-CD-005-005 | Interface Control Document Between EOSDIS Core System (ECS) and Science Computing Facilities (SCF) |
| 604-CD-002-003 | Operations Concept for the ECS Project: Part 2B -- ECS Release B |
| 505-41-12 | Goddard Space Flight Center, Interface Requirements Document between ECS and Science Computing Facilities, 5/95 |

3. Systems Descriptions

3.1 ECS - SAGE III Project Relationship Overview

The ECS at the LaRC DAAC and the LaRC SAGE III MOC work together to provide science data processing for the SAGE III instrument onboard the Russian Space Agency's Meteor-3M spacecraft scheduled for launch in August 1998. This support includes data transfer, data ingest, data processing, data distribution, and data archive. Sections 3.2 and 3.3 provide overall views of the ECS and the SAGE III Project to form a basis for understanding the interface requirements between them. Figure 3-1 illustrates the Meteor-3M/SAGE III Ground System Configuration (U.S. elements) for the ECS/SAGE III interface.

The two SAGE III interfaces between the ECS at the LaRC DAAC and the LaRC SAGE III Project are: the interface between the SAGE III Science Computing Facility (SCF) and ECS and the interface between the SAGE III MOC and ECS. This IRD defines the requirements for the interface between the MOC at LaRC and the ECS at the LaRC DAAC. The interfaces between the SCF and ECS are defined in the document 505-41-12 "Goddard Space Flight Center, Interface Requirements Document between ECS and Science Computing Facilities," 5/95 (referenced document in Section 2).

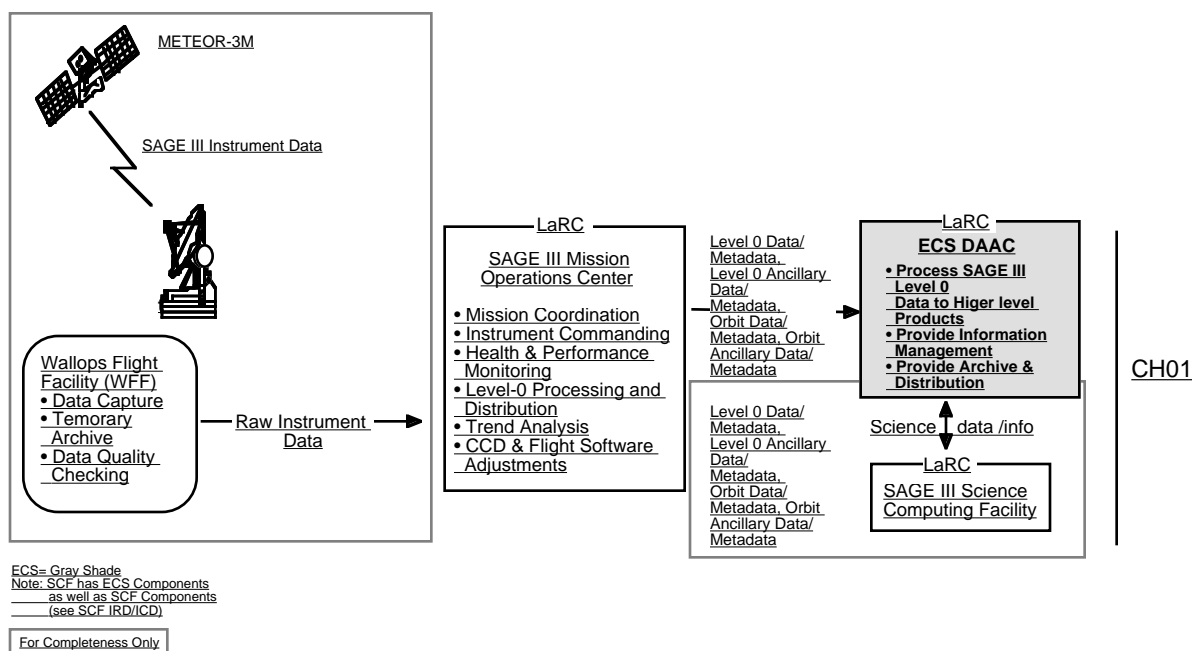


Figure 3-1. Top-Level View of SAGE III Project and ECS at the LaRC DAAC

3.2 EOSDIS Core System (ECS)

The ECS is a distributed component of the Earth Observing System (EOS) Data and Information System (EOSDIS). In addition to fully supporting the EOS series of satellites, the ECS provides information management, data processing, data archive and distribution functions for other NASA Earth science flight missions, NASA instruments flown on non-NASA spacecraft, and for other NASA held Earth science data.

3.2.1 ECS Segments

ECS is composed of three segments defined to support three major operational areas: flight operations, science data processing, and communications/system management. The ECS segments are described below:

- a. The Flight Operations Segment (FOS) manages and controls the EOS spacecraft and instruments. The FOS includes the EOS Operations Center (EOC), which is responsible for mission planning, scheduling, control, monitoring, and data analysis in support of mission operations for U.S. EOS spacecraft and instruments. The SAGE III Meteor-3M mission is a Russian spacecraft and not an EOS spacecraft. The FOS does not have responsibility for this mission. Flight operations for the SAGE III Meteor-3M mission are the responsibility of the SAGE III MOC.
- b. The Science Data Processing Segment (SDPS) provides a set of ingest, processing, archive, and distribution services for science data and a data information system for the entire EOSDIS. The SDPS processes data from the EOS instruments to Level 1-4 data products. The SDPS also provides short- and long-term storage for EOS, other Earth observing missions including SAGE III, and other related data, software, and results, and distributes the data to EOSDIS users. The SDPS contains a distributed data and information management function and user services suite for the ECS, including a catalog system in support of user data selection and ordering, including user data selection and ordering for SAGE III. SDPS elements will be distributed at the following Distributed Active Archive Centers (DAACs):
 1. Langley Research Center (LaRC), Hampton, Virginia
 2. Goddard Space Flight Center (GSFC), Greenbelt, Maryland
 3. Earth Resources Observation System (EROS) Data Center (EDC), Sioux Falls, South Dakota
 4. Jet Propulsion Laboratory (JPL), Pasadena, California
 5. University of Colorado, National Snow and Ice Data Center (NSIDC), Boulder, Colorado
 6. University of Alaska, Alaska Synthetic Aperture Radar (SAR) Facility (ASF), Fairbanks, Alaska¹
 7. Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee^{1, 3}

8. Socioeconomic Data and Applications Center (SEDAC), Saginaw, Michigan^{1, 2}

Notes: ¹These DAACs have no ECS-provided product generation capability.

²The ECS will provide no hardware or operations support to the SEDAC but will make ECS software available for reuse.

³The ECS will provide hardware and ECS software to ORNL, but will not be responsible for operational support and hardware maintenance.

- c. The Communications and System Management Segment (CSMS) provides overall ECS management of ECS ground system resources and communications/ networking services internally to ECS. CSMS provides the ECS Local Area Networks (LANs) at each of the DAACs and the EOC to support ECS operations and interfaces with EOS Backbone Network (EBnet), NASA Science Internet (NSI) and site Campus LANs. The CSMS System Monitoring and Coordination Center (SMC), along with local system management capabilities at DAAC sites and the EOC, provides system management services for ECS ground system resources. Most of the ECS operations staff is considered part of the SDPS or FOS, including Local System Management (LSM) operators.

3.2.2 ECS and the LaRC DAAC

The LaRC DAAC currently supports research in the discipline areas of radiation budget, clouds, aerosols, and tropospheric chemistry. Currently, the primary data sets of the LaRC DAAC are the following:

- a. Earth Radiation Budget Experiment (ERBE)
- b. Stratospheric Aerosol Measurement-II (SAM-II)
- c. Stratospheric Aerosol and Gas Measurement (SAGE) Experiments
- d. International Satellite Cloud Climatology Program (ISCCP)
- e. SRB (Surface Radiation Budget)
- f. FIRE (First ISCCP Regional Experiment)
- g. MAPS (Measurement of Air Pollution from Satellites)
- h. SCAR (Smoke, Clouds, and Radiation)

The ECS within the LaRC DAAC is responsible for information management, product generation, archive, and distribution of the EOS-developed data products derived from SAGE III instrument data flown onboard the Meteor-3M spacecraft as well as other EOS mission specific products. The ECS at the LaRC DAAC ingests the SAGE III Level 0 data, Level 0 ancillary data, definitive orbit data, definitive orbit ancillary data, and metadata. This interface is supported by authentication, authorization and data transfer handshaking protocols.

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3.3 SAGE III Project

NASA established the SAGE III project to develop a space-based system to observe solar and lunar occultation's in the spectral region from 0.29 to 1.55 micrometers. Using these data, the SAGE III science team will retrieve global profiles of atmospheric constituents of interest to the Earth science community.

The SAGE III instrument/experiment is an improved extension of the successful Stratospheric Aerosol Measurement II (SAM II), SAGE-I and SAGE-II experiments. The additional wavelengths and occultation that SAGE III provides will improve aerosol characterization; improve the gaseous retrievals of O₃, H₂O, and N₂O; add retrievals of NO₃ and OCIO, extend vertical range of measurements; provide a self-calibrating instrument independent of any external data needed for retrieval; and expand the sampling coverage.

The SAGE III instrument is built by the Langley Research Center (LaRC Aerosol Research Branch). The SAGE III instrument will fly on the Meteor-3M spacecraft, launched and operated by the Russian Space Agency.

3.3.1 SAGE III Mission Operations Center (MOC)

The NASA SAGE III MOC at the LaRC is responsible for the flight operations of the SAGE III instrument. In addition, the SAGE III MOC is responsible for the receipt of raw SAGE III instrument data from the NASA Wallops Flight Facility (WFF).

For the Meteor-3M / SAGE III mission, identical sets of SAGE III instrument data are relayed two times daily to ground stations located in Dolgoprudny, Russia and Wallops Island, Virginia. The WFF is responsible for data reception, archival of raw data for at least two weeks and data quality monitoring. It also supports the raw signal data analysis with quality information transfer to SAGE III MOC at LaRC.

Upon receipt at WFF, the SAGE III raw instrument data are electronically transferred to SAGE III MOC for Level 0 data conversion. Level 0 data is then distributed to the SAGE III Science Computing Facility (SCF) and to the ECS within the LaRC DAAC using the LaRC Campus LAN. Level 0 data is automatically checked at the SAGE III MOC to verify that instrument health, safety, and performance parameters are within established operating limits and performance metrics.

4. Data Flow Descriptions

4.1 Overview

Figure 4-1 depicts the data flows between the ECS and the SAGE III MOC. The operational context of each of these data flows is presented in the following sections.

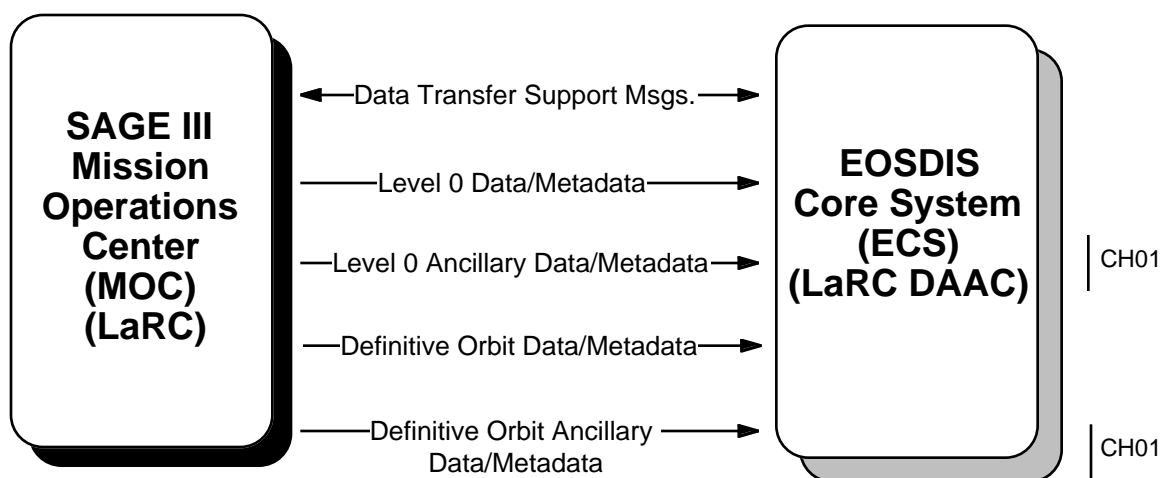


Figure 4-1. ECS at the LaRC DAAC and the SAGE II Mission Operations Center Data Flows

4.2 Message and Data Exchange

Once a day, after the SAGE III MOC completes processing of SAGE III raw instrument data to Level 0 data, a message and data transfer operation including authentication and authorization is implemented for the transfer of Level 0 data, Level 0 ancillary data, definitive orbit data, definitive orbit ancillary data and associated metadata from the SAGE III MOC to the ECS at the LaRC DAAC. The Level 0 data are CCSDS instrument packets which are frame synchronized, gap filled, time ordered non-redundant both between and within the files. (format defined in the EDOS/EGS EDOS/EGS ICD). The Level 0 metadata provides information enabling a user to search and order user to search and order data. The ancillary data from level 0 is used by the data production software running on ECS.

When the Level 0 data, and Level 0 ancillary data become available, the ECS transfers the data from an agreed upon location and completes the ingest and archival of the data. Upon successful

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ingest of the data and archival within ECS an acknowledgment is sent to the SAGE III MOC as part of the message and data transfer scenario.

5. Functional and Performance Interface Requirements

5.1 Requirements Overview

The functional and performance interface requirements identified in this document are traced to the Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System. Appendix B, Table B-1 of this document provides a listing of each IRD requirement by requirement number and an identification of its parent requirements as found in this document.

The following sections present the functional interface requirements for the ECS to SAGE III MOC interface. All requirements use electronic computer controlled processes unless otherwise specified.

5.2 Message and Data Requirements

SAGEM0010 SAGE III Mission Operations Center shall have the capability to provide and ECS at the LaRC DAAC shall have the capability to receive notification of data availability using an agreed protocol.

SAGEM0020 ECS at the LaRC DAAC shall have the capability to provide and SAGE III Mission Operations Center shall have the capability to receive acknowledgments of receipt of file transfers using an agreed protocol.

SAGEM0030 SAGE III Mission Operations Center shall have the capability to send and ECS at the LaRC DAAC shall have the capability to receive SAGE III metadata with an agreed upon format and content using an agreed file transfer protocol.

SAGEM0040 SAGE III Mission Operations Center shall have the capability to send and ECS at the LaRC DAAC shall have the capability to receive SAGE III Level 0 data as defined by CCSDS/EDOS format using an agreed file transfer protocol.

SAGEM0050 SAGE III Mission Operations Center shall have the capability to send and ECS at CH01 the LaRC DAAC shall have the capability to receive definitive orbit data using an agreed file transfer protocol.

SAGEM0060 SAGE III Mission Operations Center shall have the capability to send and ECS at CH01 the LaRC DAAC shall have the capability to receive Level 0 ancillary data using an agreed file transfer protocol.

SAGEM0070 SAGE III Mission Operations Center shall have the capability to send and ECS at CH01 the LaRC DAAC shall have the capability to receive definitive orbit ancillary data using an agreed file transfer protocol.

5.3 Security Requirements

The systems and network involved in the SAGE III Mission Operations Control Center to ECS interface are required to meet the minimum requirements directed by the Computer Security Act of 1987, the Office of Management and Budget (OMB) Circular A-130 and NASA implementing directives NASA Management Instruction (NMI) 2410.7B and NASA Handbook (NHB) 2410.9A. The sensitivity of the ECS system has been determined to be Sensitivity Level 2.

The ESDIS Security Policy in regards to file transfer is summarized as follows:

Writing to the ECS archive requires a strongly authenticated, e.g., kerberos or DCE, client. In this application if the SAGE III MOC is writing to an ECS disk, and ECS is polling that disk, SAGE III MOC must use kftp. If ECS is polling the SAGE III MOC disk, ECS will use ftp or kftp (preferred) -- the option is the SAGE III Project - MOCs.

SAGEM1010 SAGE III Mission Operations Center shall have the capability to interface with ECS at the LaRC DAAC using an agreed upon authorization and authentication protocol.

SAGEM1020 ECS at the LaRC DAAC shall have the capability to interface with SAGE III Mission Operations Center using an agreed upon authorization and authentication protocol.

5.4 Data Volume

SAGEM2010 The ECS within the LaRC DAAC shall have the capacity to support the data volumes as defined in Appendix A of this document.

6. Interface Control Documentation Plan

The ICD planned, which corresponds to this IRD, is entitled Interface Control Document Between EOSDIS Core System and Stratospheric Aerosol And Gas Experiment (SAGE III) Project. This ICD will define the functional and physical design of each interface between ECS and the SAGE III MOC, and will include the precise data contents and format of each interface. All modes (options) of data exchange for each interface will be described as well as the conditions required for each mode or option. Additionally, data rates, duty cycles, error conditions, and error handling procedures will be included. The sequence of exchanges will be completely described (e.g., required handshaking). Communications protocols or physical media will be detailed for each interface. The ICD Between ECS and Stratospheric Aerosol And Gas Experiment (SAGE III) Project will be controlled by ESDIS and SAGE III Configuration Control. Development of this ICD is the responsibility of the ECS contractor.

The ECS/SAGE III MOC interfaces are currently scheduled for implementation in ECS Release B. The delivery plan for the ICD Between ECS and SAGE III Project is as follows:

- ECS will deliver a preliminary ICD two weeks prior (April 02, 1996) to the ECS Release B Critical Design Review (CDR). This ICD will contain preliminary definitions for the ECS/SAGE III MOC interfaces.
- ECS will deliver a final ICD June 1996. This ICD will be placed under configuration control by the applicable CCBs.

It is expected that the ECS and SAGE III MOC contractors will work together closely in the development of this ICD. The ICD plan presented in this document details only the formal deliveries; it is expected that additional informal reviews and information exchanges will occur, as necessary, during the ICD development process.

Any future ECS/SAGE III Project ICDs, i.e., Space Station and Flight of Opportunity will be addressed in updates to this ICD.

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Appendix A. Data Volumes

The following estimated Data Volumes were provided by the SAGE III Project and are noted in the Technical Baseline for the ECS Project, January 1996:

The data volume of SAGE III Level 0 data, Level 0 ancillary data and associated metadata sent from the SAGE III MOC to ECS at the LaRC DAAC is 125 MB/day. | CH01

The data volume of definitive orbit data, definitive orbit ancillary data and associated metadata sent from the SAGE III MOC to ECS at the LaRC DAAC is 5 MB/day. | CH01

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Appendix B. Requirements Traceability

Table B-1 Requirements Traceability

| ECS/SAGE III IRD Requirements | Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System |
|--------------------------------------|--|
| SAGEM0010 | EOSD 1608 |
| SAGEM0020 | SDPS0080, DADS 1070,DADS 1380, DADS 1400, |
| SAGEM0030 | EOSD 1608, DADS 0170 |
| SAGEM0040 | EOSD 1608, SDPS 0020, DADS 0170 |
| SAGEM0050 | SDPS 0020, DADS0170 |
| SAGEM0060 | EOSD 1608, SDPS, 0020, DADS 0170 |
| SAGEM0070 | EOSD 1608, SDPS, 0020, DADS 0170 |
| SAGEM1010 | EOSD 1990, EOSD 2440, EOSD 2620, EOSD 2660 |
| SAGEM1020 | EOSD 1990, EOSD 2440, EOSD 2620, EOSD 2660 |
| SAGEM2010 | EOSD 1608, DADS0170, SDPS0020 |

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Abbreviations and Acronyms

| | |
|--------|---|
| CCB | Configuration Control Board |
| CDRL | Contract Data Requirements List |
| COTS | Commercial Off-the-Shelf |
| DAAC | Distributed Active Archive Center |
| DID | Data Item Description |
| DCN | Document Change Notice |
| EBnet | EOS Backbone Network |
| ECS | EOSDIS Core System |
| EDOS | EOS Data and Operations System |
| EOS | Earth Observing System |
| EOSDIS | EOS Data and Information System |
| ESDIS | Earth Science Data and Information System |
| FDF | Flight Dynamics Facility |
| GPS | Global Positioning Satellite |
| GSFC | Goddard Space Flight Center |
| ICD | Interface Control Document |
| IRD | Interface Requirements Document |
| ISCCP | International Satellite Cloud Climatology Program |
| ISO | International Standards Organization |
| LaRC | Langley Research Center |
| MOC | Missions Operations Center |
| MOM | Mission Operations Manager |
| MOU | Memoranda of Understanding |
| NASA | National Aeronautical and Space Administration |
| Nascom | NASA Communications |
| QA | Quality Assurance |

| | |
|-------|---|
| QC | Quality Control |
| SAGE | Stratospheric Aerosol and Gas Experiment |
| SCF | Science Computing Facility |
| SMC | System Monitoring and Coordination Center |
| TBD | To Be Determined |
| TDRSS | Tracking Data Relay Satellite System |
| WFF | Wallops Flight Facility |